



SMART GROWTH INDEX[®]

A Sketch Tool for Community Planning

Version 2.0

Steward Guide

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Prepared for the
U.S. ENVIRONMENTAL PROTECTION AGENCY
by
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1. Installation

The Steward Guide is intended to help advanced users designated as SGI “model stewards” perform certain installation and maintenance tasks. When preparing to install SGI, stewards should note the following:

- The user login name used during the installation of SGI must be the same one that will be used to operate the software.
- SGI installation requires that the user login have administrator-level privileges. The installing user’s login privileges may need to be increased temporarily for the purposes of installing SGI. Consult your network administrator for assistance. SGI does not require administrator-level privileges to run once installed.

Preparing for Installation

SGI should be installed with the assistance of your organization’s designated “model steward.” To install SGI, you must be running Microsoft Windows 95, 98, NT (4.0 or later), or 2000 (service pack 2 or later).

- Close all running programs.
- Close or disable virus-protection software to prevent installation conflicts.
- To install SGI on Windows NT or 2000 you must have administrator rights.

Minimum PC hardware requirements are a 300 MHz processor, 128 MB of RAM, and 1.5 GB of hard disk space. The minimum screen resolution is 1024 x 768.

Installing from CD

On most Windows systems, installation starts automatically when you insert the SGI CD into your CD-ROM drive. If installation does not start automatically when you insert the SGI CD, you can install SGI using the following steps:

- Insert the SGI CD into your CD-ROM drive.
- From the Start menu, choose Run.
- Type *d:\setup*, where *d* is the letter assigned to your CD-ROM drive.

- Click OK.

Once the setup program begins, it will guide you through the installation process.

2. Indicator-Data Relationships

Accompanying this Steward Guide is a spreadsheet workbook called “SGI2_Indicator-Data_Relationships_Workbook.xls”. A printout of the workbook is included as Appendix A. It depicts relationships between indicators and data, sorted by indicator and data source type (shapefiles, UDPs). It has the following worksheet tabs:

- “Shapefiles and Attributes”: this sheet lists details about each of the shapefile types eligible to be used in SGI. In addition to describing the shapefile types, it identifies the shapefile attributes (.dbf columns) that each shapefile must have if all of the indicators are to be available to run. The ShapefileID and AttributeID values are referenced subsequent Indicator-Data Relationships sheets (see below).
- “User Defined Parameters”: this sheet lists each SGI's user defined parameter, including a UDP_ID referenced on the subsequent Indicator-Data Relationships sheets (see below). To assist the user in locating the correct UDP, the corresponding node in SGI's treeview pane is identified, as well as a sample screen capture of the particular UDP.
- “I-D Relationships” sheets (3): these sheets list each indicator and the ShapefileID(s), AttributeID(s) and UDP_ID(s) that a user of SGI must supply for a sketch, if the indicator is to run successfully. The content of each sheet is identical, except that one is ordered by Indicator Series ID, one by ShapefileID, and one by UDP_ID.
- “Indicator Mapping”: this sheet shows the location of the indicator mapping data in the SGDB2000.mdb database.

3. Data Format Requirements

All GIS data inputs have the following format requirements:

- ESRI standard shapefiles only (Point, PolyLine, Polygon).
- Shapefile names must follow the traditional 8.3 naming convention.
- All shapefiles in a sketch must have the same projection; unprojected shapefiles are not allowed.
- All shapefiles in a sketch must be in the same units (either meters or feet).

- No measured shapefiles (pointM, polylineM, polygonM) or 3D shapefiles (pointZ, polylineZ, polygonZ).
- No MultiPoint shapes in point shapefiles.
- No multipart PolyLine or Polygon shapes. *See Data Checker below for a diagnostic check.*
- No overlapping or duplicate shapes. *See Data Checker below for a diagnostic check.*
- No duplicate named Attributes (two fields with the same name). *See Data Checker below for a diagnostic check.*
- No nulls in records. *See Data Checker below for a diagnostic check.*
- Certain attributes may be required to be formatted with a specific data type (e.g., integer) and to be in specific units (e.g. square feet). See Appendix A for details.
- Polygon shapefiles must not have “bad” (open) polygons. *See Data Checker below for a diagnostic check.*

Specific shapefiles have the following requirements:

- *Land-Use.* All land-use polygons should be contiguous, with no overlaps and no gaps between them.
- *Employment.* All employment points should intersect a polygon in the existing land-use layer used in the same sketch. Points should be located on employment parcels as close to the actual business entrance as possible.
- *Street Centerlines.* No “undershoots” (segments closer than a user-defined tolerance distance, but not touching). *See Data Checker below for a diagnostic function.* No self-intersecting segments, e.g., “lollipops” (these will cause logical network errors). *See Data Checker below for a diagnostic function.* No false “brunnels” (lines that *should* form a real world intersection, but which only cross or touch in the data). *See Data Checker below for a function that identifies all intersections.* No zeros in Street Width attribute field.
- *Hydrologic Soils and Rainfall.* NRCS hydrologic group attribute must be one of “A”, “B”, “C” or “D” only. If values like A/D are included, the right most value will be used. The rainfall file must be a text data file containing two comma-separated columns: date, rainfall (inches). There must be at least 10 years (3,650 rows) of data in this file. Soil and rainfall data will be provided to each EPA partner community at the time of SGI software delivery. In addition to these data,

Appendix B describes common sources of soils information, and other rainfall data may be available from local Weather Bureau offices.

- *Best Management Practices (BMP)*. The shapefile should describe the extent of the BMP's effectiveness, not necessarily the location of the BMP device.

4. Data Checker

Included with SGI is a Data Checker (built as an ArcView 3.2 extension) with a menu of options for diagnosing and fixing data problems. The Data Checker file is called "DATA_CHECKER_1.avx". Supporting extensions included in the package are:

- geoproc.avx – ESRI Geoprocessing
- projutil.avx – ESRI Projection Utility Wizard
- snap2other.avx – Snap features to other theme
- themetools.avx – Theme Tools 1.0
- vectorx1.avx – Vector Transformations 1.0
- xtools3.avx – XTools (06/01/01)

These extensions are also freely available on the ESRI ArcScripts website. They were included in the Data Checker to provide added functions that may be useful in data preparation. Loading the Data Checker is done as follows:

- It is a standard ArcView extension, so it goes in the \$AVEXT folder within a standard ArcView installation (typically found at C:\ESRI\AV_GIS30\ARCVIEW\EXT32).
- The supporting extensions included with the Data Checker should also be put in \$AVEXT.
- Open a new or existing project. Use the ArcView Extension Manager to load the extension.

The Data Checker is operated through menu items and their respective diagnostic functions. Shift-click on menu items to see specific instructions for each diagnostic function. The diagnostic/repair functions included are:

- ▶ Bad Poly Scan
- ▶ Find/Fix Nulls In Fields
- ▶ Find/Remove Duplicate Records
- ▶ Find/Remove Duplicate Fields
- ▶ Find Multipart Shapes
- ▶ Find Undershoots
- ▶ Find Self-Intersecting Segments
- ▶ Get Intersections

See Appendix C for more details on these functions.

5. Changing Default UDP Values

Many of the UDPs are supplied with defaults which, during the course of building a sketch, the user may over-ride with more accurate settings. So that the user does not have to repeatedly make the same UDP changes for every new sketch, certain UDPs can have their defaults over-ridden. The Getting Started Guide details how a user of SGI can save changes to the Parcel Development UDP settings as defaults to be available for future sketches. However, a steward can go farther and alter the following additional UDP defaults: Planned Land-Use, Population, Infrastructure, and Resources and Emissions.

Warning: *Before opening the SGDB2000.MDB file to change UDP defaults, the main database file should be backed up before making any changes to it. The main database stores many other important tables that should not be altered. Damaging the main database will result in SGI not running properly or not running at all. The user should also be very familiar with MS Access before attempting to modify the main database.*

1. To open the database, locate the SGDB2000.MDB file in the SGI application folder (default location is C:\Program Files\Criterion\SmartGrowth2\SGDB2000.MDB).
2. Double-click the file to open it.
3. Click the Forms tab in the database window.
4. Double-click the “Defaults_Main” form. The following form appears:

SGI 2.0 UDP Default Editor [Finish]

Planned Land-Use Defaults

Planned Land Use Class	Land Use Type	Residential	Non-Residential
BOLT92AR1	Res	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BOLT92C	Non-buildable	<input type="checkbox"/>	<input type="checkbox"/>
BOLT92R2	Res	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BOLT92V1	Both	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
BOLT92V2	Both	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
BUELBUEL	No zoning	<input type="checkbox"/>	<input type="checkbox"/>
BUURL99C	Both	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
BUURL99CBD	Both	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Record: 1 of 208

Population Defaults

Regional Pop	146571	Regional Emp	79000
Avg persons per household:		Avg workers per household:	
Single Family	2.66	Single Family	1.4
Mobile Home	2.08	Mobile Home	1.4
Multi-Family 2-4	2.08	Multi-Family 2-4	1.4
Multi-Family 5-up	2.08	Multi-Family 5-up	1.4
Group Quarters	2	Group Quarters	0.4

Infrastructure Defaults

Wastewater production (gal/DU/day):	
Single Family	173
Mobile Home	135.2
Multi-Family, 2-4	135.2
Multi-Family, 5 up	135.2
Group Quarters	130
Wastewater production (gal/emp/day):	
Worker	30

5. Scroll down through the form to access the other default tables.
6. Click the Finish button when done.

6. Tips and Tricks

- Warning:**
- *Before opening the SGDB2000.MDB file, it is wise to back up the main database file before making any changes to it. The main database stores many other important tables that should not be altered. Damaging the main database will result in SGI not running properly or not running at all. The user should also be very familiar with MS Access before attempting to modify the main database.*
 - *Before using Microsoft File Manager to copy any files, be sure to back up the destination files and/or folders. Otherwise, a steward mistake or a system disk error may result in SGI not running properly or not running at all.*

Moving a Sketch Between Computers

SGI does not provide the option of selectively importing and exporting individual sketches between SGI installations on separate computers or over a network. This is because of the integrated nature of the data contained within SGDB2000.MDB and SGWAT.MDB. However, a steward does have the ability to move an entire SGI installation's data set from one machine to another. This is done by ensuring that the following files and folders are moved from the application root on one machine to the application root on another machine.

Both computers must have the same version of SGI installed prior to executing this transfer. The following files/folders are to be part of the file copy transfer (referenced to the application root, which by default is C:\Program Files\Criterion\SmartGrowth2):

1. C:\Program Files\Criterion\SmartGrowth2\SGDB2000.mdb.
2. C:\Program Files\Criterion\SmartGrowth2\SG_Error.log.
3. All folders inside C:\Program Files\Criterion\SmartGrowth2 prefixed "Micro," e.g. C:\Program Files\Criterion\SmartGrowth2\Micro1 (there will be one of these "Micro" folders for every sketch created in SGI).

4. The C:\Program Files\Criterion\SmartGrowth2\SGWAT folder.
5. The C:\Program Files\Criterion\SmartGrowth2\Data folder.

Once these files have been copied over to the destination machine, run SGI normally and you will be able to work with all the sketches from the source machine.

Re-Using Central Node Shapefiles

SGI requires that you use the SGI interface and its draw tools to create a “Central Nodes” shapefile (the Central Nodes option under the Sketch Area treeview node). However, if a user wants to ensure that two separate sketches share the same set of identical Central Nodes, this can be accomplished two ways:

- If the two sketches to share the central nodes are both to be base sketches or are both to be alternate sketches, use the Copy button in the Snapshot Sketch Manager to create the second sketch only AFTER the first sketch has been entirely created.
- If one sketch is to be base and another alternate, or if the two sketches already exist, then a steward needs only to create a set of dummy Central Nodes in the second sketch; once this is done, use Microsoft File Manager to open the shapefile folder of the first sketch containing the desired Central Nodes shapefile, and copy all files named “CntrNds” to the second sketch’s shapefile folder, overwriting the dummy central nodes shapefile created previously. If there are many shapefile folders prefixed “Micro”, open SGDB2000.MDB’s MicroProjects table and identify the ProjectID for both sketches. (If a sketch has project ID 5, that’s sketch’s shapefiles will be stored in the “Micro5” folder, etc.).

SGWATER Application

The SGWATER application is built as an MS-Access 2000 .mdb file located by default in “C:\Program Files\Criterion\SmartGrowth2\SGWAT\SGWAT.mdb” Clicking on the Advanced button on SGI’s SGWATER Application dialog, or double clicking this file on a machine with MS-Access installed, will open the application’s internal manager. The following menu appears:

The screenshot shows a 'Main Menu' dialog box with a blue title bar. It contains a 'Current Scenario:' label above a text input field. Below this, the text 'First, choose a scenario.' is followed by three options: 'Select a Scenario' (with a folder icon), 'New Scenario', and 'Save Current Scenario as a New Scenario'. The next section, 'Then select from the following options...', lists eight options: 'Import Rainfall Data', 'Set Growing Season', 'Edit Site Data', 'Edit Site BMPs', 'Edit Land Uses, EMCs, and Curve Numbers', 'Update Curve Numbers by SGI 2 Land Use Class', 'Edit BMP Percent Removal Efficiencies', and 'View Results for Current Scenario'. The final section, 'Other Options...', includes 'Run Several Scenarios' and 'Delete Scenarios'. All options are preceded by unchecked checkboxes.

Main Menu

Current Scenario:

First, choose a scenario.

- ☐ Select a Scenario
- ☐ New Scenario
- ☐ Save Current Scenario as a New Scenario

Then select from the following options...

- ☐ Import Rainfall Data
- ☐ Set Growing Season
- ☐ Edit Site Data
- ☐ Edit Site BMPs
- ☐ Edit Land Uses, EMCs, and Curve Numbers
- ☐ Update Curve Numbers by SGI 2 Land Use Class
- ☐ Edit BMP Percent Removal Efficiencies
- ☐ View Results for Current Scenario

Other Options...

- ☐ Run Several Scenarios
- ☐ Delete Scenarios

This menu can be used by SGI stewards for accessing and updating the SGWATER application. It is important to note that SGWATER is presently configured in SGI for evaluating urban land-uses under antecedent moisture condition (AMC) 2 that applies to average soil moisture levels. If a sketch involves

non-urban land-uses, the steward must update the methodology's curve numbers. This is accomplished on the menu above by clicking on Update Curve Numbers by SGI 2 Land-Use Class. This will produce a warning about the update process, and a series of dialogs for entering curve numbers by soil group type and SGI land-use class being updated. This procedure should only be performed by a steward that has reviewed SGWATER documentation and is familiar with the methodology. Tables 6.1 through 6.3 have been excerpted from SGWATER documentation for quick-reference guidance on updating curve numbers for non-urban land-uses.

Table 6.1
**LAND-USE CATEGORIES AND CURVE NUMBERS
 BY SOIL TYPE FOR AMC II**

Land Use Category	Characteristics	Curve Number by Soil Type			
		A	B	C	D
Residential	Average lot 1/8 acre or less, 65% average impervious area	77	85	90	92
	Average lot 1/4 acre, 38% average impervious area	61	75	83	87
	Average lot 1/3 acre, 30% average impervious area	57	72	81	86
	Average lot 1/2 acre, 25% average impervious area	54	70	80	85
	Average lot 1 acre, 20% average impervious area	51	68	79	84
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets	Paved with curb and gutter	98	98	98	98
	Gravel	76	85	89	91
	Dirt	72	82	87	89
Commercial and business areas	85% impervious	81	88	91	93
Mixture of above land uses	85% impervious	89	92	94	95
Industrial districts	72% impervious	81	88	91	93
Open spaces	Grass cover on 75% or more of the area	39	61	74	80
	Grass cover on 50 – 75% of the area	49	69	79	84
Fallow	Straight row	77	86	91	94
Row Crops	Straight row, poor condition	72	81	88	91
	Straight row, good condition	67	78	85	89
Pasture or range	Poor condition	47	67	81	88
	Fair condition	25	59	75	83
	Good condition	6	35	70	79
Meadow	Good condition	30	58	71	78
Woods or forest	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Farmsteads		59	74	82	86

Note: the curve numbers obtained from this table must be adjusted to account for antecedent moisture conditions other than AMC II. Table 2 is used to extrapolate curve numbers for AMC I and III. The characteristics for the land use categories presented in Table 4 are based on traditional development patterns. For example, a traditional quarter acre lot development is approximately 38% impervious. A non-traditional pattern might build up rather than out (reducing the building footprint) and/or might include narrower streets and sidewalks to further reduce the impervious area. The user can evaluate the sensitivity of the non-point pollutant loading to various development options by simply adjusting the percent impervious assumption for a given land use. It is imperative that the user evaluates the default assumptions for each selected land use and makes appropriate modifications to percent imperviousness (or curve number) to accurately represent the designed or built physical conditions associated with the given land use.

Source: EPA/GKY

Table 6.2
CURVE NUMBERS EXTRAPOLATION FOR AMC I AND II

Curve Number for AMC II	Corresponding Curve Number	
	AMC I	AMC III
100	100	100
95	87	99
90	78	98
85	70	97
80	63	94
75	57	91
70	51	87
65	45	83
60	40	79
55	35	75
50	31	70
45	27	65
40	23	60
35	19	55
30	15	50
25	12	45
20	9	39
15	7	33
10	4	26
5	2	17
0	0	0

Source: EPA/GKY

Table 6.3
**EVENT MEAN CONCENTRATION BY LAND-USE
 CLASSIFICATIONS MODIFIED FROM CCBNEP**

B&J Land- Use	Description	Units	Pollutants		
			Total Nitrogen	Total Phosphorus	Suspended Solids
<i>Residential</i>	<i>Single-family residential</i>	<i>mg/L</i>	<i>1.82000</i>	<i>0.57000</i>	<i>41.00000</i>
	<i>Mobile home park</i>	<i>mg/L</i>	<i>1.82000</i>	<i>0.57000</i>	<i>41.00000</i>
	<i>Multi-family residential, moderate density</i>	<i>mg/L</i>	<i>1.82000</i>	<i>0.57000</i>	<i>41.00000</i>
	<i>Multi-family residential, high density</i>	<i>mg/L</i>	<i>1.82000</i>	<i>0.57000</i>	<i>41.00000</i>
	<i>Other residential</i>	<i>mg/L</i>	<i>1.82000</i>	<i>0.57000</i>	<i>41.00000</i>
<i>Commercial</i>	<i>Commercial, office</i>	<i>mg/L</i>	<i>1.34000</i>	<i>0.32000</i>	<i>55.50000</i>
	<i>Commercial, retail or service</i>	<i>mg/L</i>	<i>1.34000</i>	<i>0.32000</i>	<i>55.50000</i>
<i>Mixed</i>	<i>Commercial/office/residential mix</i>	<i>mg/L</i>	<i>1.57000</i>	<i>0.35000</i>	<i>57.90000</i>
	<i>Commercial/residential mix</i>	<i>mg/L</i>	<i>1.57000</i>	<i>0.35000</i>	<i>57.90000</i>
	<i>Commercial/office mix</i>	<i>mg/L</i>	<i>1.57000</i>	<i>0.35000</i>	<i>57.90000</i>
	<i>Shopping Center</i>	<i>mg/L</i>	<i>1.57000</i>	<i>0.35000</i>	<i>57.90000</i>
<i>Industrial</i>	<i>Light industrial</i>	<i>mg/L</i>	<i>1.26000</i>	<i>0.28000</i>	<i>60.50000</i>
	<i>Heavy industrial</i>	<i>mg/L</i>	<i>1.26000</i>	<i>0.28000</i>	<i>60.50000</i>
	<i>Warehouse/storage</i>	<i>mg/L</i>	<i>1.26000</i>	<i>0.28000</i>	<i>60.50000</i>
<i>Commercial</i>	<i>Public Assembly</i>	<i>mg/L</i>	<i>1.34000</i>	<i>0.32000</i>	<i>55.50000</i>
	<i>Institutional</i>	<i>mg/L</i>	<i>1.34000</i>	<i>0.32000</i>	<i>55.50000</i>
	<i>School</i>	<i>mg/L</i>	<i>1.34000</i>	<i>0.32000</i>	<i>55.50000</i>
<i>Open/ Undeveloped</i>	<i>Park</i>	<i>mg/L</i>	<i>1.50000</i>	<i>0.12000</i>	<i>70.00000</i>
	<i>Open space</i>	<i>mg/L</i>	<i>1.50000</i>	<i>0.12000</i>	<i>70.00000</i>
<i>Agricultural</i>	<i>Agricultural, general</i>	<i>mg/L</i>	<i>4.40000</i>	<i>1.30000</i>	<i>107.00000</i>
	<i>Agriculture, livestock</i>	<i>mg/L</i>	<i>0.70000</i>	<i>0.01000</i>	<i>1.00000</i>
	<i>Agricultural, crops</i>	<i>mg/L</i>	<i>4.40000</i>	<i>1.30000</i>	<i>107.00000</i>
<i>Transportation</i>	<i>Rights-of-way</i>	<i>mg/L</i>	<i>1.86000</i>	<i>0.22000</i>	<i>73.50000</i>
	<i>Parking</i>	<i>mg/L</i>	<i>1.86000</i>	<i>0.22000</i>	<i>73.50000</i>
<i>Open/ Undeveloped</i>	<i>Vacant</i>	<i>mg/L</i>	<i>1.50000</i>	<i>0.12000</i>	<i>70.00000</i>
	<i>Other/miscellaneous</i>	<i>mg/L</i>	<i>0.00000</i>	<i>0.00000</i>	<i>0.00000</i>

Source: EPA/GKY

Appendix A INDICATOR-DATA RELATIONSHIP WORKBOOK

SGI 2 Shapefiles and Attributes -- Referenced in the "Indicator-Data Relationships" Table by ShapefileID (AttributeID)

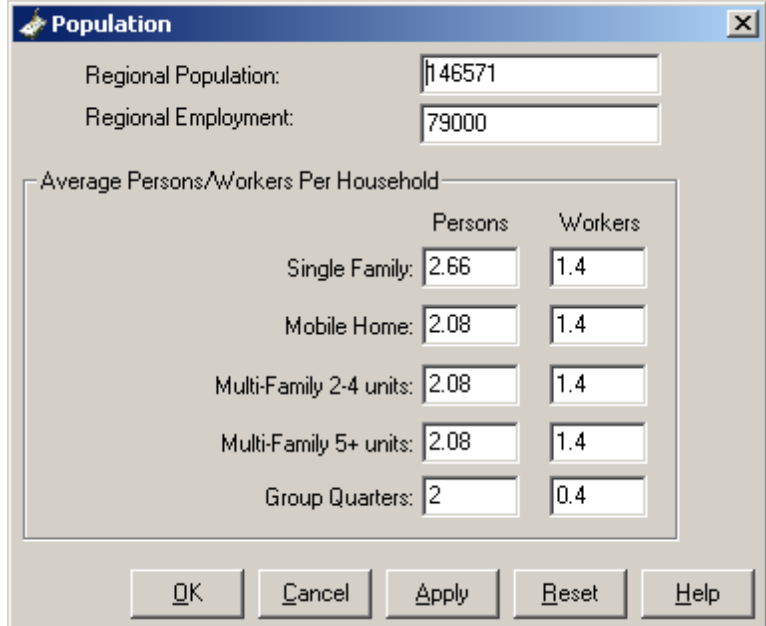
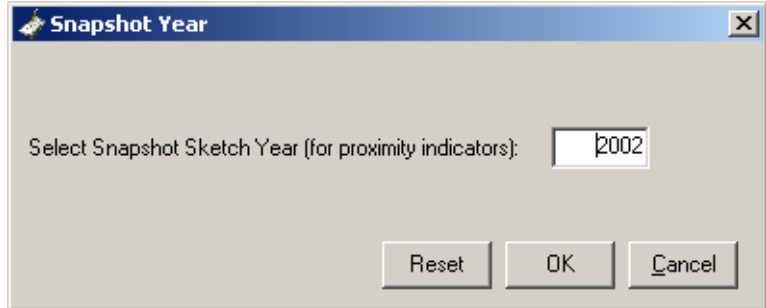
Shapefile Information			Attribute Information			
Shapefile Description	Type	ShapefileID	AttributeID	Attribute Description	DataType ²	Notes
Planned Land-Use	Polygon	LandUse	LandUseClass	Planned land-use type	Text	<i>See Steward's Guide for directions on changing defaults</i>
Existing Land-Use (Base or Alternate)	Polygon	Parcels	DUType	Dwelling unit type	Text	All unique values will be classified into one of: SF, MH, MF2-4, MF5+, GQ
			DUCount	Dwelling unit count	Numeric	Applies to residential parcels only
			BuildingSqFt	Non-residential building square footage	Numeric	Applies to non-residential parcels only
			OffStreetPkg	Supply of off-street parking spaces	Numeric	
			ExLandUse	Parcel land use-type	Text	<i>See ParcelDevelopment UDP for required data by ExLandUse</i> <i>See Steward's Guide for directions on changing defaults</i>
Employment	Point	Employment	EmpCount	Employment count	Numeric	
Employment Centers	Point	EmpCenters	(none)			
Parks and Schools	Polygon	ParksSchools	Year	Year park available	4-digit year	2000 for existing Parks and Schools
Schools and Daycare Centers	Point	SchoolsDaycare	Year	Year facility available	4-digit year	2000 for existing Schools and Daycare Facilities
Key Services/Amenities	Point	KeyServiceAmenities	Year	Year service available	4-digit year	2000 for existing key services
Central Business Districts	Point	CBD	(none)			Can be several CBDs in a region
Street Centerlines	Line	StreetCL	StreetWidth	Street width	Numeric	
				Sidewalk count	Numeric	0 (none), 1, 2
				Supply of on-street parking spaces	Numeric	
Bicycle Routes	Line	BicycleRoutes	Year	Year route segment available	4-digit year	2000 for existing bicycle route segments
Transit Routes	Line	TransitRoutes	Year	Year route segment available	4-digit year	2000 for existing transit route segments
Transit Stops	Point	TransitStops	(none)			
Light Rail Transit Stations	Point	LRTStations	HasParking	Station has parking	Boolean	
			IsTerminus	Station is terminus station on line	Boolean	
Hydrologic Soils	Polygon	HydrologicSoils	HydrologicClass	Hydrological class	Text	One of: A, B, C, or D
Best Management Practices	Polygon	BMP	RemTSS	Percent TSS removal	Numeric	
			RemPhos	Percent phos. removal	Numeric	
			RemNitro	Percent nitro. removal	Numeric	
Local Government Boundaries	Polygon	Boundaries	Class	Boundary name	Text	Names of Boundary areas
³ Sketch Boundary	Polygon	SketchBd				
³ Central Nodes	Point	CntrNd				
³ Sketch Grid	Polygon	Grid				

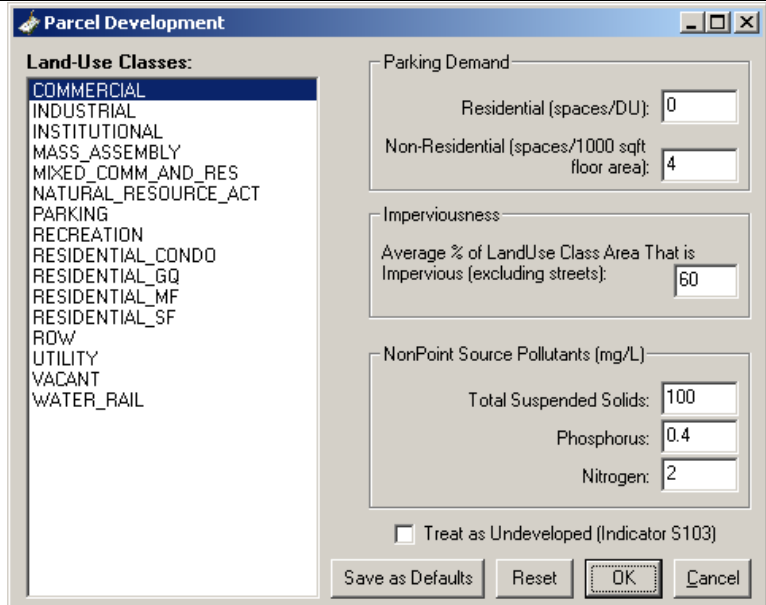
¹ = All shapefiles must to follow an 8.3 naming convention (e.g., "xxxxyyy.shp")

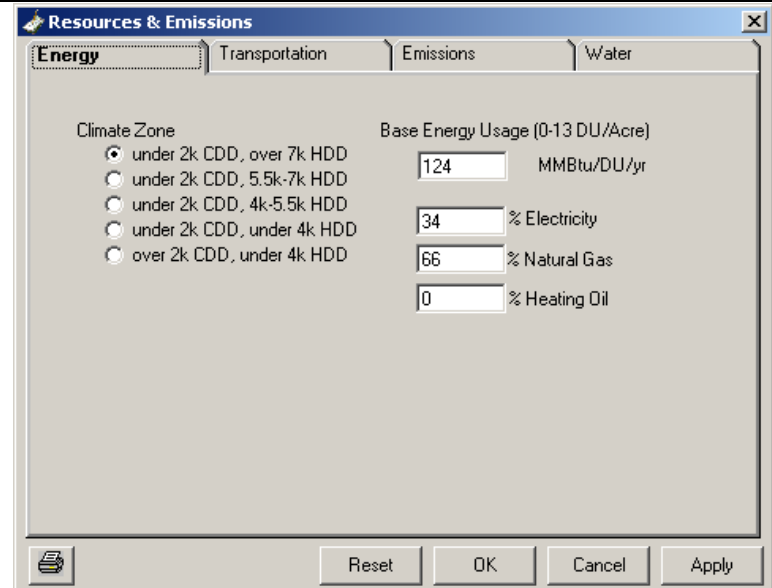
² = No blanks/nulls allowed in any attribute with a restricted DataType

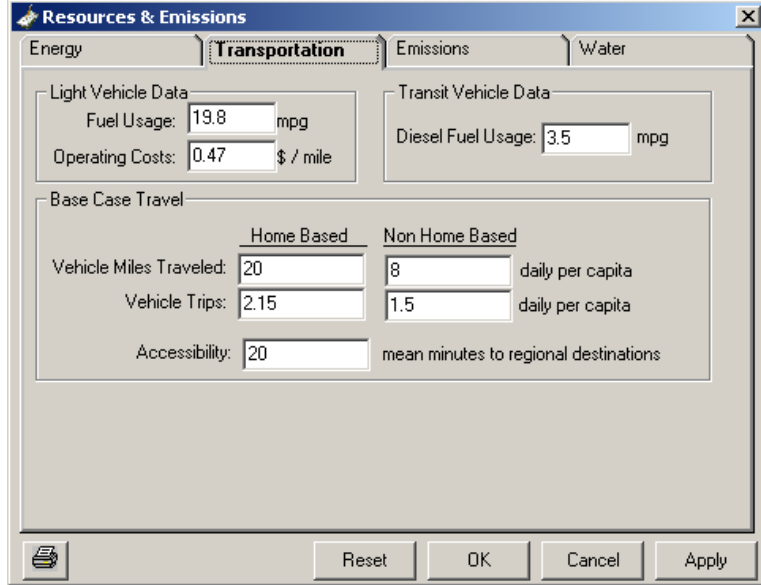
³ = created within SGI2, not supplied by user

SGI2 User Defined Parameters (UDP) Referenced in the "Indicator-Data Relationships" Table by UDP_ID

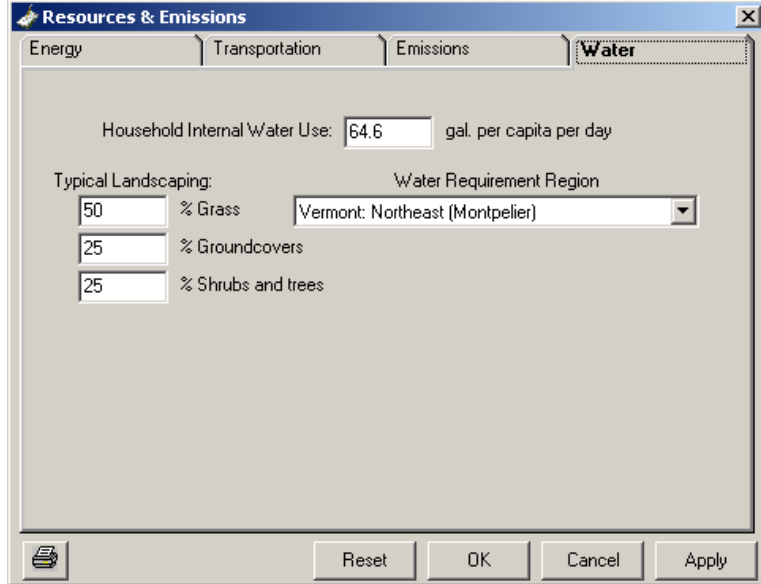
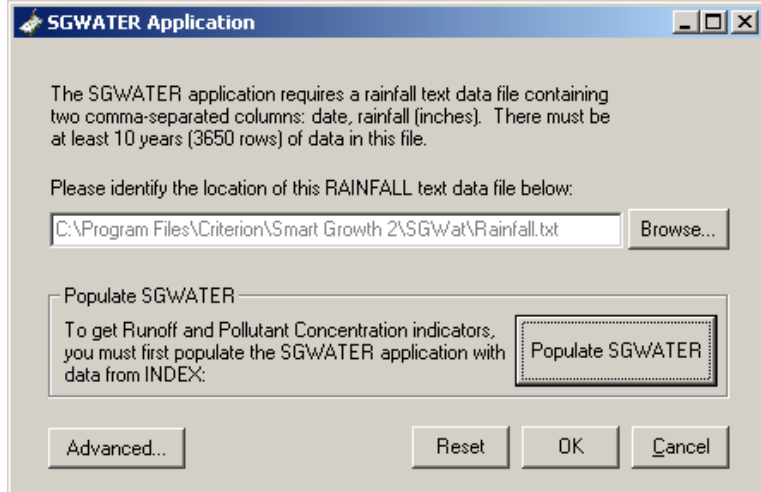
UDP_ID	SGI2 "User Defined Parameter" node name	Sample Screen Capture
Population.Snapshot	Population	
Other.SnapshotYear	Snapshot Year	

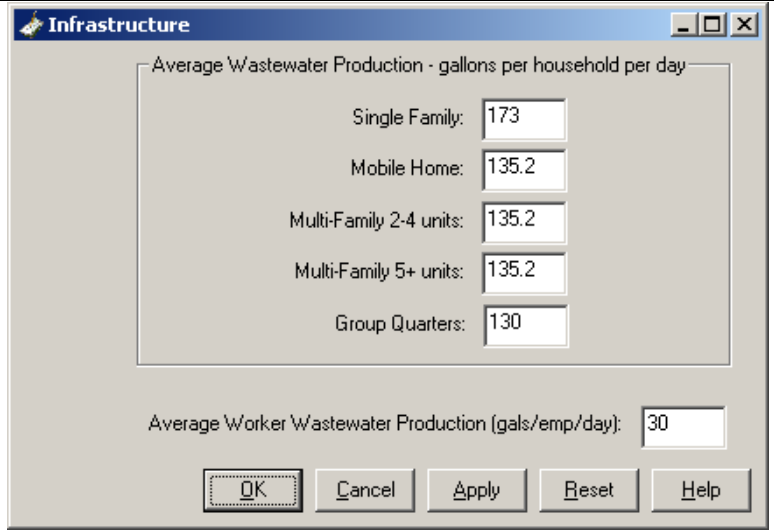
UDP_ID	SGI2 "User Defined Parameter" node name	Sample Screen Capture
ParcelDevelopment	Parcel Development	

UDP_ID	SGI2 "User Defined Parameter" node name	Sample Screen Capture
Resources.ResidentialEnergy	Resources and Emissions, Energy tab	 <p>The screenshot shows the 'Resources & Emissions' dialog box with the 'Energy' tab selected. The 'Climate Zone' section has five radio button options, with the first one ('under 2k CDD, over 7k HDD') selected. The 'Base Energy Usage (0-13 DU/Acre)' section has a text box containing '124' and the unit 'MMBtu/DU/yr'. Below this, there are three more text boxes: '% Electricity' with '34', '% Natural Gas' with '66', and '% Heating Oil' with '0'. At the bottom of the dialog are five buttons: 'Print' (with a printer icon), 'Reset', 'OK', 'Cancel', and 'Apply'.</p>

UDP_ID	SGI2 "User Defined Parameter" node name	Sample Screen Capture
Resources.Transportation	Resources and Emissions, Transportation tab	 <p>The screenshot shows the 'Resources & Emissions' dialog box with the 'Transportation' tab selected. The 'Light Vehicle Data' section contains 'Fuel Usage' set to 19.8 mpg and 'Operating Costs' set to 0.47 \$/mile. The 'Transit Vehicle Data' section contains 'Diesel Fuel Usage' set to 3.5 mpg. The 'Base Case Travel' section is divided into 'Home Based' and 'Non Home Based' columns. Under 'Home Based', 'Vehicle Miles Traveled' is 20, 'Vehicle Trips' is 2.15, and 'Accessibility' is 20. Under 'Non Home Based', 'Vehicle Miles Traveled' is 8, 'Vehicle Trips' is 1.5, and 'Accessibility' is 20. The units for the last two rows are 'daily per capita' and 'mean minutes to regional destinations' respectively. At the bottom are buttons for 'Reset', 'OK', 'Cancel', and 'Apply'.</p>

UDP_ID	SGI2 "User Defined Parameter" node name	Sample Screen Capture																																								
Resources.Emissions	Resources and Emissions, Emissions tab	<div><div>Resources & Emissions</div><div><div>Energy</div><div>Transportation</div><div>Emissions</div><div>Water</div></div><div><div>Building (lb/MMBtu)</div><table><thead><tr><th></th><th>NOx</th><th>SOx</th><th>HC</th><th>CO</th><th>CO2</th><th>PM</th></tr></thead><tbody><tr><td>Electricity:</td><td>0.413</td><td>0.6514</td><td>0.003</td><td>0.0206</td><td>125.65</td><td>0.0653</td></tr><tr><td>Natural Gas:</td><td>0.137</td><td>0.0005</td><td>0.0005</td><td>0.034</td><td>115</td><td>0.003</td></tr><tr><td>Heating Oil:</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></tbody></table></div><div><div>Transportation (g/mi)</div><table><thead><tr><th></th><th>NOx</th><th>HC</th><th>CO</th><th>CO2</th><th>PM</th></tr></thead><tbody><tr><td>Light Vehicle:</td><td>1.7</td><td>3.3</td><td>25.5</td><td>453.6</td><td>0</td></tr></tbody></table></div></div> <div><div></div><div>Reset</div><div>OK</div><div>Cancel</div><div>Apply</div></div>		NOx	SOx	HC	CO	CO2	PM	Electricity:	0.413	0.6514	0.003	0.0206	125.65	0.0653	Natural Gas:	0.137	0.0005	0.0005	0.034	115	0.003	Heating Oil:	0	0	0	0	0	0		NOx	HC	CO	CO2	PM	Light Vehicle:	1.7	3.3	25.5	453.6	0
	NOx	SOx	HC	CO	CO2	PM																																				
Electricity:	0.413	0.6514	0.003	0.0206	125.65	0.0653																																				
Natural Gas:	0.137	0.0005	0.0005	0.034	115	0.003																																				
Heating Oil:	0	0	0	0	0	0																																				
	NOx	HC	CO	CO2	PM																																					
Light Vehicle:	1.7	3.3	25.5	453.6	0																																					

UDP_ID	SGI2 "User Defined Parameter" node name	Sample Screen Capture
Resources.Water	Resources and Emissions, Water tab	
Other.StormwaterRunoff	SGWater Application	

UDP_ID	SGI2 "User Defined Parameter" node name	Sample Screen Capture
Other.InfrastructureSnapshot	Infrastructure	 <p>The screenshot shows a dialog box titled "Infrastructure". It contains a section titled "Average Wastewater Production - gallons per household per day" with five input fields: "Single Family" (173), "Mobile Home" (135.2), "Multi-Family 2-4 units" (135.2), "Multi-Family 5+ units" (135.2), and "Group Quarters" (130). Below this section is a field for "Average Worker Wastewater Production (gals/emp/day)" with a value of 30. At the bottom are buttons for "OK", "Cancel", "Apply", "Reset", and "Help".</p>

SGI 2 Indicator-Data Relationships Table

Small Area Snapshots

Mapped indicators are calculated by property parcels in a user-designated sketch area; unmapped indicators are calculated for the entire sketch area.

ID	Indicator Name	Sketch Type	Required Shapefiles by ShapefileID (AttributeID)	User Defined Parameters by UDP_ID	Map	Linked External Application
Snapshot Land-Use (S100 series)						
S100	Population density (persons per gross acre including residents and employees; used in 4D method).		Parcels (DUCount, DUType); Employment (EmpCount)	Population.Snapshot	✓	
S101	Use mix (index of use dissimilarity among grid cells).		Parcels (ExLandUse); Grid		✓	
S102	Parcel size (avg size of parcels in sq ft).		Parcels		✓	
S103	Developed acres (total developed residential and nonresidential net acres divided by total number of residents).		Parcels (DUCount, DUType); Employment	Population.Snapshot; ParcelDevelopment		
S104	Use diversity (study area pop/emp vs. region pop/emp needed for 4D method).		Parcels (DUCount, DUType); Employment (EmpCount)	Population.Snapshot		
Snapshot Housing (S200 series)						
S200	Conforming density (DU/net acre of residential land).		Parcels (DUCount); LandUse (LandUseClass)		✓	
S201	Nonconforming density (DU/net acre of all land).		Parcels (DUCount)		✓	
S202	Single-family share (% of DU that are SF).		Parcels (DUCount, DUType)		✓	
S203	Mobile home share (% of DU that are MH).		Parcels (DUCount, DUType)		✓	
S204	Multi-family 2-4 share (% of DU that are MF 2-4 units).		Parcels (DUCount, DUType)		✓	
S205	Multi-family 5+ share (% of DU that are MF 5 or more units).		Parcels (DUCount, DUType)		✓	
S206	Group quarters share (% of DU that are GQ).		Parcels (DUCount, DUType)		✓	
S207	Transit proximity (avg distance from all DU to closest transit stop in ft).		Parcels (DUCount); StreetCL; TransitStops		✓	
S208	Recreation proximity (avg distance to closest park or school in ft).		Parcels (DUCount); StreetCL; ParksSchools (Year)	Other.SnapshotYear	✓	
S209	Education proximity (avg distance to closest school and/or day care in mi).		Parcels (DUCount); StreetCL; SchoolsDaycare (Year)	Other.SnapshotYear	✓	
S210	Key service/amenity proximity (avg. distance to closest key service/amenity in mi.).		Parcels (DUCount); StreetCL; KeyServiceAmenities (Year)	Other.SnapshotYear	✓	
S211	Multi-modal access (% of DU served by three or more of four modes: street, sidewalk, transit route, bicycle route).		Parcels (DUCount); StreetCL (sidewalk); TransitRoutes; BicycleRoutes	Other.SnapshotYear	✓	
S212	Employment proximity (avg distance to user selected regional employers in mi).		Parcels (DUCount); StreetCL; EmpCenters		✓	
S213	Residential Water Use (gal/day/capita)		Parcels (DUCount, DUType)	Resources.Water		
S214	Energy consumption (MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Base:	Parcels (DUCount, DUType)	Resources.ResidentialEnergy; Resources.Transportation; Population.Snapshot	✓	
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.ResidentialEnergy; Resources.Transportation; Population.Snapshot	✓	

Small Area Snapshots

Mapped indicators are calculated by property parcels in a user-designated sketch area; unmapped indicators are calculated for the entire sketch area.

ID	Indicator Name	Sketch Type	Required Shapefiles by ShapefileID (AttributeID)	User Defined Parameters by UDP_ID	Map	Linked External Application
Snapshot Employment (S300 series)						
S300	Employment (total number of employees).		Employment (EmpCount)		✓	
S301	Jobs/housed workers balance (ratio of total jobs to total housed workers).		Parcels (DUCount, DUType); Employment (EmpCount)	Population.Snapshot		
S302	Conforming density (employees per net acre of employment-designated land).		Employment (EmpCount); Parcels; LandUse (LandUseClass)		✓	
S303	Nonconforming density (employees per net acre of all land).		Employment (EmpCount); Parcels		✓	
S304	Transit proximity (avg distance to closest transit stop in ft).		Employment (EmpCount); TransitStops		✓	
Snapshot Environment (S400 series)						
S400	Imperviousness (amount of impervious surface in acres per DU).		Parcels (ExLandUse, DUCount); StreetCL (StreetWidth); SketchBd	Other.StormwaterRunoff; ParcelDevelopment		SGWATER (w/ Rainfall .txt file)
S401	Stormwater runoff (cubic feet / year).		Parcels (ExLandUse); HydrologicSoils (HydrologicClass); BMP (RemTSS, RemPhos, RemNitro); StreetCL (StreetWidth)	Other.StormwaterRunoff; ParcelDevelopment		SGWATER (w/ Rainfall .txt file)
S402	Total suspended solid nonpoint pollutants (kg/yr).		Parcels; HydrologicSoils; BMP (RemTSS, RemPhos, RemNitro); StreetCL (StreetWidth)	Other.StormwaterRunoff; ParcelDevelopment		SGWATER (w/ Rainfall .txt file)
S403	Phosphate nonpoint pollutants (kg/yr).		Parcels; HydrologicSoils; BMP (RemTSS, RemPhos, RemNitro); StreetCL (StreetWidth)	Other.StormwaterRunoff; ParcelDevelopment		SGWATER (w/ Rainfall .txt file)
S404	Nitrogen nonpoint pollutants (kg/yr).		Parcels; HydrologicSoils; BMP (RemTSS, RemPhos, RemNitro); StreetCL (StreetWidth)	Other.StormwaterRunoff; ParcelDevelopment		SGWATER (w/ Rainfall .txt file)
S407	Open Space (% of total land area that is open space)		Parcels (ExLandUse)		✓	
S408	Park space availability (park and schoolyard acres/1,000 persons).		Parcels (DUCount); ParksSchools (Year)	Other.SnapshotYear		
Snapshot Infrastructure (S500 series)						
S500	Residential wastewater production (total gallons/day).		Parcels (DUType, DUCount)	Other.InfrastructureSnapshot		
S501	Nonresidential wastewater production (total gallons/day).		Employment (EmpCount)	Other.InfrastructureSnapshot		
S502	Street centerline distance (total street centerline distance in ft.)		StreetCL; SketchBd			
Snapshot Transportation (S600 series)						
S600	Sidewalk completeness (ratio of total sidewalk centerline distance vs. total street centerline distance; used in 4D method).		StreetCL (sidewalk); SketchBd		✓	
S601	Pedestrian route directness (average ratio of walking distances from random sample origin points to central node versus straight line distances between same points; used in 4D method).		Parcels; CntrNd; StreetCL		✓	
S602	Street network density (street centerline mi./sq.mi.; used in 4D method).		StreetCL; SketchBd			
S603	Street connectivity (ratio of intersections vs. intersections and cul-de-sacs).		StreetCL; SketchBd		✓	
S605	Bicycle network coverage (% of total street centerline distance)		StreetCL; BicycleRoutes (Year); SketchBd	Other.SnapshotYear	✓	

Small Area Snapshots

Mapped indicators are calculated by property parcels in a user-designated sketch area; unmapped indicators are calculated for the entire sketch area.

ID	Indicator Name	Sketch Type	Required Shapefiles by ShapefileID (AttributeID)	User Defined Parameters by UDP_ID	Map	Linked External Application
	total bike route distance).					
S606	Transit service coverage (transit stops per sq mi).		TransitStops			
S607	Regional accessibility (mean travel time to all other regional destinations weighted by mode shares).	Base:	n/a (manually derived from ITM)	Resources.Transportation		
		Alternate:	n/a (manually derived from ITM)	Resources.Transportation		
S608	Home-based vehicle trips (VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	n/a (manually derived from ITM)	Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Transportation		
S609	Non-home-based vehicle trips (VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	n/a (manually derived from ITM)	Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Transportation		
S610	Home-based vehicle miles traveled (VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	n/a (manually derived from ITM)	Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Transportation		
S611	Non-home-based vehicle miles traveled (VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	n/a (manually derived from ITM)	Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Transportation		
S612	Parking demand (required parking spaces at user-defined rates).		Parcels (ExLandUse, BuildingSqFt)	ParcelDevelopment		
S613	Parking supply (number of on-street and off-street spaces).		Parcels (OffStreetPkg); StreetCL (OnStreetPkg); SketchBd			
S614	Transit service density (miles of transit routes multiplied by number of transit vehicles traveling those routes each day, divided by total sketch area in acres).		TransitRoutes (Headway, Year); SketchBd	Other.SnapshotYear		
S615	Rail transit boardings (average number of persons boarding light rail transit daily per station).		LRTStations (IsTerminal, HasParking); CBD; Parcels (DUCount, DUType); Employment (EmpCount); SketchBd	Population.Snapshot		
Snapshot Air Quality & Climate Change (S700 series)						
S700	Carbon monoxide (CO) vehicle emissions (lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount, DUType)	Resources.Emissions; Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Emissions; Resources.Transportation		

Small Area Snapshots						
Mapped indicators are calculated by property parcels in a user-designated sketch area; unmapped indicators are calculated for the entire sketch area.						
ID	Indicator Name	Sketch Type	Required Shapefiles by ShapefileID (AttributeID)	User Defined Parameters by UDP_ID	Map	Linked External Application
S701	Hydrocarbon (HC) vehicle emissions (lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount, DUType)	Resources.Emissions; Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Emissions; Resources.Transportation		
S702	Sulphur oxide (SOx) vehicle emissions (lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount, DUType)	Resources.Emissions; Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Emissions; Resources.Transportation		
S703	Particulate matter (PM) vehicle emissions (lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount, DUType)	Resources.Emissions; Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Emissions; Resources.Transportation		
S704	Nitrogen oxide (NOx) vehicle emissions (lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount, DUType)	Resources.Emissions; Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Emissions; Resources.Transportation		
S705	Carbon dioxide (CO2) vehicle emissions (tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount, DUType)	Resources.Emissions; Resources.Transportation		
		Alternate:	Parcels (DUCount, DUType); Employment (EmpCount); StreetCL (sidewalk); SketchBd; CntrNds	Resources.Emissions; Resources.Transportation		

SGI 2 Data-Indicator Relationships Table 1 (Shapefiles and Fields)

ID	Indicator Name	Definition	For Sketch Type	Required Shapefiles by ShapefileID (AttributeID)
S211	Multi-modal access	(% of DU served by three or more of four modes: street, sidewalk, transit route, bicycle route).		BicycleRoutes
S605	Bicycle network coverage	(% of total street centerline distance total bike route distance).		BicycleRoutes (Year)
S401	Stormwater runoff	(cubic feet / year).		BMP (RemNitro)
S402	Total suspended solid nonpoint pollutants	(kg/yr).		BMP (RemNitro)
S403	Phosphate nonpoint pollutants	(kg/yr).		BMP (RemNitro)
S404	Nitrogen nonpoint pollutants	(kg/yr).		BMP (RemNitro)
S401	Stormwater runoff	(cubic feet / year).		BMP (RemPhos)
S402	Total suspended solid nonpoint pollutants	(kg/yr).		BMP (RemPhos)
S403	Phosphate nonpoint pollutants	(kg/yr).		BMP (RemPhos)
S404	Nitrogen nonpoint pollutants	(kg/yr).		BMP (RemPhos)
S401	Stormwater runoff	(cubic feet / year).		BMP (RemTSS)
S402	Total suspended solid nonpoint pollutants	(kg/yr).		BMP (RemTSS)
S403	Phosphate nonpoint pollutants	(kg/yr).		BMP (RemTSS)
S404	Nitrogen nonpoint pollutants	(kg/yr).		BMP (RemTSS)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	CntrNds
S601	Pedestrian route directness	(average ratio of walking distances from random sample origin points to central node versus straight line distances between same points; used in 4D method).		CntrNds
S604	Pedestrian environment design	(4D method index of street network density, sidewalk completeness, and pedestrian route directness). Calculated based on Indicator #S600, #S601 and #S602.		CntrNds
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	CntrNds
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	CntrNds
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	CntrNds
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	CntrNds
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	CntrNds
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	CntrNds
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	CntrNds
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	CntrNds
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	CntrNds
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	CntrNds
S212	Employment proximity	(avg distance to user selected regional employers in mi).		EmpCenters
S103	Developed acres	(total developed residential and nonresidential net acres divided by total number of residents).		Employment
S100	Population density	(persons per gross acre including residents and employees; used in 4D method).		Employment (EmpCount)
S104	Use diversity	(study area pop/emp vs. region pop/emp needed for 4D method).		Employment (EmpCount)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator	Alternate:	Employment (EmpCount)

ID	Indicator Name	Definition	For Sketch Type	Required Shapefiles by ShapefileID (AttributeID)
		#S610, #S611		
S300	Employment	(total number of employees).		Employment (EmpCount)
S301	Jobs/housed workers balance	(ratio of total jobs to total housed workers).		Employment (EmpCount)
S302	Conforming employment density	(employees per net acre of employment-designated land).		Employment (EmpCount)
S303	Nonconforming employment density	(employees per net acre of all land).		Employment (EmpCount)
S304	Transit proximity to employment	(avg distance to closest transit stop in ft).		Employment (EmpCount)
S501	Nonresidential wastewater production	(total gallons/day).		Employment (EmpCount)
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Employment (EmpCount)
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Employment (EmpCount)
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Employment (EmpCount)
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Employment (EmpCount)
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		Employment (EmpCount)
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Employment (EmpCount)
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Employment (EmpCount)
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Employment (EmpCount)
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Employment (EmpCount)
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Employment (EmpCount)
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Employment (EmpCount)
S101	Use mix	(index of use dissimilarity among grid cells).		Grid
S401	Stormwater runoff	(cubic feet / year).		HydrologicSoils (HydrologicClass)
S402	Total suspended solid nonpoint pollutants	(kg/yr).		HydrologicSoils (HydrologicClass)
S403	Phosphate nonpoint pollutants	(kg/yr).		HydrologicSoils (HydrologicClass)
S404	Nitrogen nonpoint pollutants	(kg/yr).		HydrologicSoils (HydrologicClass)
S210	Key service/amenity proximity	(avg. distance to closest key service/amenity in mi.).		KeyServiceAmenities (Year)
S200	Conforming housing density	(DU/net acre of residential land).		LandUse (LandUseClass)
S302	Conforming employment density	(employees per net acre of employment-designated land).		LandUse (LandUseClass)
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		Light Rail Transit Stations (HasParking)
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		Light Rail Transit Stations (IsTerminal)
S102	Parcel size	(avg size of parcels in sq ft).		Parcels
S302	Conforming employment density	(employees per net acre of employment-designated land).		Parcels
S303	Nonconforming employment density	(employees per net acre of all land).		Parcels
S601	Pedestrian route directness	(average ratio of walking distances from random sample origin points to central node versus straight line distances between same points; used in 4D method).		Parcels
S604	Pedestrian environment design	(4D method index of street network density, sidewalk completeness, and pedestrian route directness). Calculated based on Indicator #S600, #S601 and #S602.		Parcels
S100	Population density	(persons per gross acre including residents and employees; used in 4D method).		Parcels (DUCount)
S103	Developed acres	(total developed residential and nonresidential net acres divided by total number of residents).		Parcels (DUCount)

ID	Indicator Name	Definition	For Sketch Type	Required Shapefiles by ShapefileID (AttributeID)
S104	Use diversity	(study area pop/emp vs. region pop/emp needed for 4D method).		Parcels (DUCount)
S200	Conforming housing density	(DU/net acre of residential land).		Parcels (DUCount)
S201	Nonconforming housing density	(DU/net acre of all land).		Parcels (DUCount)
S202	Single-family share	(% of DU that are SF).		Parcels (DUCount)
S203	Mobile home share	(% of DU that are MH).		Parcels (DUCount)
S204	Multi-family 2-4 share	(% of DU that are MF 2-4 units).		Parcels (DUCount)
S205	Multi-family 5+ share	(% of DU that are MF 5 or more units).		Parcels (DUCount)
S206	Group quarters share	(% of DU that are GQ).		Parcels (DUCount)
S207	Transit proximity to housing	(avg distance from all DU to closest transit stop in ft).		Parcels (DUCount)
S208	Recreation proximity to housing	(avg distance to closest park or school in ft).		Parcels (DUCount)
S209	Education proximity to housing	(avg distance to closest school and/or day care in mi).		Parcels (DUCount)
S210	Key service/amenity proximity	(avg. distance to closest key service/amenity in mi.).		Parcels (DUCount)
S211	Multi-modal access	(% of DU served by three or more of four modes: street, sidewalk, transit route, bicycle route).		Parcels (DUCount)
S212	Employment proximity	(avg distance to user selected regional employers in mi).		Parcels (DUCount)
S213	Residential Water Use	(gal/day/capita)		Parcels (DUCount)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	Parcels (DUCount)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Base:	Parcels (DUCount)
S301	Jobs/housed workers balance	(ratio of total jobs to total housed workers).		Parcels (DUCount)
S400	Imperviousness	(amount of impervious surface in acres per DU).		Parcels (DUCount)
S408	Park space availability	(park and schoolyard acres/1,000 persons).		Parcels (DUCount)
S500	Residential wastewater production	(total gallons/day).		Parcels (DUCount)
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUCount)
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUCount)
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUCount)
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUCount)
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		Parcels (DUCount)
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUCount)
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount)
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUCount)
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount)
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUCount)
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount)
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUCount)
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount)
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUCount)

ID	Indicator Name	Definition	For Sketch Type	Required Shapefiles by ShapefileID (AttributeID)
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount)
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUCount)
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUCount)
S100	Population density	(persons per gross acre including residents and employees; used in 4D method).		Parcels (DUType)
S103	Developed acres	(total developed residential and nonresidential net acres divided by total number of residents).		Parcels (DUType)
S104	Use diversity	(study area pop/emp vs. region pop/emp needed for 4D method).		Parcels (DUType)
S202	Single-family share	(% of DU that are SF).		Parcels (DUType)
S203	Mobile home share	(% of DU that are MH).		Parcels (DUType)
S204	Multi-family 2-4 share	(% of DU that are MF 2-4 units).		Parcels (DUType)
S205	Multi-family 5+ share	(% of DU that are MF 5 or more units).		Parcels (DUType)
S206	Group quarters share	(% of DU that are GQ).		Parcels (DUType)
S213	Residential Water Use	(gal/day/capita)		Parcels (DUType)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	Parcels (DUType)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Base:	Parcels (DUType)
S301	Jobs/housed workers balance	(ratio of total jobs to total housed workers).		Parcels (DUType)
S500	Residential wastewater production	(total gallons/day).		Parcels (DUType)
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUType)
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUType)
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUType)
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Parcels (DUType)
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		Parcels (DUType)
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUType)
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUType)
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUType)
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUType)
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUType)
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUType)
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUType)
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUType)
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUType)
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUType)
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Parcels (DUType)
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Parcels (DUType)
S101	Use mix	(index of use dissimilarity among grid cells).		Parcels (ExLandUse)
S400	Imperviousness	(amount of impervious surface in acres per DU).		Parcels (ExLandUse)

ID	Indicator Name	Definition	For Sketch Type	Required Shapefiles by ShapefileID (AttributeID)
S401	Stormwater runoff	(cubic feet / year).		Parcels (ExLandUse)
S402	Total suspended solid nonpoint pollutants	(kg/yr).		Parcels (ExLandUse)
S403	Phosphate nonpoint pollutants	(kg/yr).		Parcels (ExLandUse)
S404	Nitrogen nonpoint pollutants	(kg/yr).		Parcels (ExLandUse)
S407	Open Space	(% of total land area that is open space)		Parcels (ExLandUse)
S612	Parking demand	(required parking spaces at user-defined rates).		Parcels (ExLandUse)
S613	Parking supply	(number of on-street and off-street spaces).		Parcels (OffStreetPkg)
S208	Recreation proximity to housing	(avg distance to closest park or school in ft).		ParksSchools (Year)
S408	Park space availability	(park and schoolyard acres/1,000 persons).		ParksSchools (Year)
S209	Education proximity to housing	(avg distance to closest school and/or day care in mi).		SchoolsDaycare (Year)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	SketchBd
S400	Imperviousness	(amount of impervious surface in acres per DU).		SketchBd
S502	Street centerline distance	(total street centerline distance in ft.).		SketchBd
S600	Sidewalk completeness	(ratio of total sidewalk centerline distance vs. total street centerline distance; used in 4D method).		SketchBd
S602	Street network density	(street centerline mi./sq.mi.; used in 4D method).		SketchBd
S603	Street connectivity	(ratio of intersections vs. intersections and cul-de-sacs).		SketchBd
S604	Pedestrian environment design	(4D method index of street network density, sidewalk completeness, and pedestrian route directness). Calculated based on Indicator #S600, #S601 and #S602.		SketchBd
S605	Bicycle network coverage	(% of total street centerline distance total bike route distance).		SketchBd
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	SketchBd
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	SketchBd
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	SketchBd
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	SketchBd
S613	Parking supply	(number of on-street and off-street spaces).		SketchBd
S614	Transit service density	(miles of transit routes multiplied by number of transit vehicles traveling those routes each day divided by total sketch area in acres).		SketchBd
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		SketchBd
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	SketchBd
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	SketchBd
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	SketchBd
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	SketchBd
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	SketchBd
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	SketchBd
S207	Transit proximity to housing	(avg distance from all DU to closest transit stop in ft).		StreetCL
S208	Recreation proximity to housing	(avg distance to closest park or school in ft).		StreetCL
S209	Education proximity to housing	(avg distance to closest school and/or day care in mi).		StreetCL

ID	Indicator Name	Definition	For Sketch Type	Required Shapefiles by ShapefileID (AttributeID)
S210	Key service/amenity proximity	(avg. distance to closest key service/amenity in mi.).		StreetCL
S212	Employment proximity	(avg distance to user selected regional employers in mi).		StreetCL
S601	Pedestrian route directness	(average ratio of walking distances from random sample origin points to central node versus straight line distances between same points; used in 4D method).		StreetCL
S602	Street network density	(street centerline mi./sq.mi.; used in 4D method).		StreetCL
S603	Street connectivity	(ratio of intersections vs. intersections and cul-de-sacs).		StreetCL
S605	Bicycle network coverage	(% of total street centerline distance total bike route distance).		StreetCL
S613	Parking supply	(number of on-street and off-street spaces).		StreetCL (OnStreetPkg)
S211	Multi-modal access	(% of DU served by three or more of four modes: street, sidewalk, transit route, bicycle route).		StreetCL (sidewalk)
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	StreetCL (sidewalk)
S502	Street centerline distance	(total street centerline distance in ft.).		StreetCL (sidewalk)
S600	Sidewalk completeness	(ratio of total sidewalk centerline distance vs. total street centerline distance; used in 4D method).		StreetCL (sidewalk)
S604	Pedestrian environment design	(4D method index of street network density, sidewalk completeness, and pedestrian route directness). Calculated based on Indicator #S600, #S601 and #S602.		StreetCL (sidewalk)
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	StreetCL (sidewalk)
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	StreetCL (sidewalk)
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	StreetCL (sidewalk)
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	StreetCL (sidewalk)
S614	Transit service density	(miles of transit routes multiplied by number of transit vehicles traveling those routes each day divided by total sketch area in acres).		StreetCL (sidewalk)
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		StreetCL (sidewalk)
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	StreetCL (sidewalk)
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	StreetCL (sidewalk)
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	StreetCL (sidewalk)
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	StreetCL (sidewalk)
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	StreetCL (sidewalk)
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	StreetCL (sidewalk)
S400	Imperviousness	(amount of impervious surface in acres per DU).		StreetCL (StreetWidth)
S211	Multi-modal access	(% of DU served by three or more of four modes: street, sidewalk, transit route, bicycle route).		TransitRoutes

ID	Indicator Name	Definition	For Sketch Type	Required Shapefiles by ShapefileID (AttributeID)
S614	Transit service density	(miles of transit routes multiplied by number of transit vehicles traveling those routes each day divided by total sketch area in acres).		TransitRoutes (Headway)
S614	Transit service density	(miles of transit routes multiplied by number of transit vehicles traveling those routes each day divided by total sketch area in acres).		TransitRoutes (Year)
S207	Transit proximity to housing	(avg distance from all DU to closest transit stop in ft).		TransitStops
S304	Transit proximity to employment	(avg distance to closest transit stop in ft).		TransitStops
S606	Transit service coverage	(transit stops per sq mi).		TransitStops

SGI 2 Data-Indicator Relationships Table 2 (User-Defined Parameters)

ID	Indicator Name	Definition	For Sketch Type	User-Defined Parameters by UDP_ID ¹
S400	Imperviousness	(amount of impervious surface in acres per DU).		ParcelDevelopment
S401	Stormwater runoff	(cubic feet / year).		ParcelDevelopment
S402	Total suspended solid nonpoint pollutants	(kg/yr).		ParcelDevelopment
S403	Phosphate nonpoint pollutants	(kg/yr).		ParcelDevelopment
S404	Nitrogen nonpoint pollutants	(kg/yr).		ParcelDevelopment
S407	Open Space	(% of total land area that is open space)		ParcelDevelopment
S500	Residential wastewater production	(total gallons/day).		Other.InfrastructureSnapshot
S501	Nonresidential wastewater production	(total gallons/day).		Other.InfrastructureSnapshot
S208	Recreation proximity to housing	(avg distance to closest park or school in ft).		Other.SnapshotYear
S209	Education proximity to housing	(avg distance to closest school and/or day care in mi).		Other.SnapshotYear
S210	Key service/amenity proximity	(avg. distance to closest key service/amenity in mi.).		Other.SnapshotYear
S211	Multi-modal access	(% of DU served by three or more of four modes: street, sidewalk, transit route, bicycle route).		Other.SnapshotYear
S408	Park space availability	(park and schoolyard acres/1,000 persons).		Other.SnapshotYear
S605	Bicycle network coverage	(% of total street centerline distance total bike route distance).		Other.SnapshotYear
S614	Transit service density	(miles of transit routes multiplied by number of transit vehicles traveling those routes each day divided by total sketch area in acres).		Other.SnapshotYear
S401	Stormwater runoff	(cubic feet / year).		Other.StormwaterRunoff
S402	Total suspended solid nonpoint pollutants	(kg/yr).		Other.StormwaterRunoff
S403	Phosphate nonpoint pollutants	(kg/yr).		Other.StormwaterRunoff
S404	Nitrogen nonpoint pollutants	(kg/yr).		Other.StormwaterRunoff
S100	Population density	(persons per gross acre including residents and employees; used in 4D method).		Population.Snapshot
S103	Developed acres	(total developed residential and nonresidential net acres divided by total number of residents).		Population.Snapshot
S104	Use diversity	(study area pop/emp vs. region pop/emp needed for 4D method).		Population.Snapshot
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	Population.Snapshot
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Base:	Population.Snapshot
S301	Jobs/housed workers balance	(ratio of total jobs to total housed workers).		Population.Snapshot
S615	Rail transit boardings	(average number of persons boarding light rail transit daily per station).		Population.Snapshot
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Emissions
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Emissions
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Emissions
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Emissions
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Emissions
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Emissions
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Emissions

ID	Indicator Name	Definition	For Sketch Type	User-Defined Parameters by UDP_ID ¹
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Emissions
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Emissions
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Emissions
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Emissions
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Emissions
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Emissions
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	Resources.ResidentialEnergy
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Base:	Resources.ResidentialEnergy
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Alternate:	Resources.Transportation
S214	Energy consumption	(MMBtu/yr/capita for housing and auto travel). Calculation is based partly on results of Indicator #S610, #S611	Base:	Resources.Transportation
S607	Regional accessibility	(mean travel time to all other regional destinations weighted by mode shares).	Alternate:	Resources.Transportation
S607	Regional accessibility	(mean travel time to all other regional destinations weighted by mode shares).	Base:	Resources.Transportation
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Resources.Transportation
S608	Home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	Resources.Transportation
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Resources.Transportation
S609	Non-home-based vehicle trips	(VT/day/capita). Base Projects report simply the VT UDP. For Alternate Projects, VT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	Resources.Transportation
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Resources.Transportation
S610	Home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	Resources.Transportation
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Alternate:	Resources.Transportation
S611	Non-home-based vehicle miles traveled	(VMT/day/capita). Base Projects report simply the VMT UDP. For Alternate Projects, VMT is calculated based partly on alternate Indicators #S101, #S104, #S604 and base case Indicator #S607.	Base:	Resources.Transportation
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Transportation
S700	Carbon monoxide (CO) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Transportation
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Transportation
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Transportation
S701	Hydrocarbon (HC) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Transportation
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Transportation
S702	Sulphur oxide (SOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Transportation
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Transportation
S703	Particulate matter (PM) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Transportation
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Transportation
S704	Nitrogen oxide (NOx) vehicle emissions	(lbs/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Transportation

ID	Indicator Name	Definition	For Sketch Type	User-Defined Parameters by UDP_ID ¹
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Alternate:	Resources.Transportation
S705	Carbon dioxide (CO2) vehicle emissions	(tons/yr/capita). Calculated based partly on Indicator #S214, #S610 and #S611	Base:	Resources.Transportation
S213	Residential Water Use	(gal/day/capita)		Resources.Water

1 = See UDP Defaults Workbook for details on the UDPs.

Appendix B

SOIL DATA SOURCES

GIS data for soils typically comes from two main sources:

- The U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS).
- Local cities, counties and regions that conduct more detailed soil surveys.

NRCS data sets are the Soil Survey Geographic Data Base (SSURGO) and State Soil Geographic Database (STATSGO).

SSURGO

Soil Survey Geographic data are the most detailed level of digital soils data available from the NRCS. A SSURGO data set consists of map data, attribute data, and metadata. The map extent for a SSURGO data set is a soil survey area, which may consist of a county, multiple counties, or parts of multiple counties.

- **Map Data.** SSURGO map data include soil survey area boundaries, soil boundaries, water boundaries, and conventional and special soil features. Map data are collected in 7.5-minute or 3.75 minute quadrangle units and are available in ARC interchange (.e00) file format and modified Digital Line Graph (DLG-3) optional format.
- **Attribute Data.** SSURGO attribute data contain both estimated and measured physical and chemical properties and soil interpretations for engineering, water management, recreation, agronomic, woodland, range, and wildlife uses of the soil. The data are distributed in ASCII format with the ARC interchange and DLG-3 map files.
- **Metadata.** A metadata text file in ASCII format is distributed with each SSURGO data set. This file describes the content, quality, condition, history, and other characteristics of the data.
- **SSURGO Digitizing.** Before a soil survey area can be digitized, the mapping base must meet national map accuracy standards. Acceptable bases are either orthophotoquadrangles (DOQ) or 7.5-minute quadrangles. If a survey area was originally mapped on another base, the lines are manually transferred to an acceptable base. Digitizing is done by line segment (vector) format in accordance with NRCS digitizing standards and specifications. Soil boundaries ending at quad neat lines are matched exactly to adjoining soil boundaries within a survey area.
- **SSURGO Certification.** For certification, a SSURGO data set must meet all standards and specifications as described in the NRCS National Soil Survey Handbook. This includes a 100 percent digital data review by a certification center. After a data set is certified, it is archived and distributed through the NRCS National Cartography and Geospatial Center in Fort Worth, Texas.

- *Availability and Distribution of SSURGO Data.* A general SSURGO description, SSURGO listing and metadata, status map, data users guide, SSURGO download, and ordering information are all available on the NRCS National SSURGO database website (http://www.ftw.nrcs.usda.gov/ssur_data.html).

STATSGO

Soil maps for the State Soil Geographic (STATSGO) data base are made by generalizing the detailed soil survey data. The mapping scale for STATSGO map is 1:250,000 (with the exception of Alaska, which is 1:1,000,000). The level of mapping is designed to be used for broad planning and management uses covering state, regional, and multi-state areas. Attributes, metadata, accuracy and certification details are otherwise identical to SSURGO. STATSGO data are available on the NRCS National STATSGO database website (http://www.ftw.nrcs.usda.gov/stat_data.html).

Detailed soils data is best located by inquiring with the local jurisdictions. Often statewide GIS data clearinghouse can be found which contain the soils data. While SSURGO is often the starting point for such data, attribute, metadata and accuracy details may vary.

Sgi set-up requires that the soils shapefile have a hydrologic group attribute. This attribute is typically found with the SSURGO and STATSGO attribute data table named "core" in the field Hydgrp. Regional and local soil data may have this data stored in a different field.

Appendix C DATA CHECKER INSTRUCTIONS

Bad Poly Scan

Scans all polys in all poly themes in the current view for "bad" polys (start and end vertices are not equal).

- The view must contain an active polygon theme.

Find/Fix Nulls In Fields

Replaces numeric nulls from selected fields with replacement value (e.g. 0).

Replaces string nulls from selected fields with replacement value (e.g. "--").

- Searches all records.
- The view must contain an active feature theme.

Find/Remove Duplicate Records

Searches for duplicate values in a selected field in the attribute table (.dbf) of the active theme.

- Searches all records.
- Use the Shape field to identify duplicate shapes.
- Use a supposedly unique ID field to identify duplicate IDs.
- The active document must be a view and must contain at least one active feature theme.

Find/Remove Duplicate Fields

Finds and removes duplicate fields in the attribute table (.dbf) of the active theme.

- The active document must be a view and must contain at least one active feature theme.

Find Multipart Shapes

Adds a field called Parts, containing the part count for each shape, to the attribute table (dbf) of the active theme.

- Searches all shapes.
- The active document must be a view and must contain at least one active feature theme.

Find Overlapping Polygons

- Searches for polys in the active theme that are overlapping.
- Searches selected shapes (or all shapes, if none are selected).
- Shows overlaps as graphics.
- The active document must be a view and must contain at least one active polygon theme.

Find Undershoots

Searches for segments in the active theme that are within a gap tolerance.

- Searches selected shapes (or all shapes, if none are selected).
- The active document must be a view and must contain at least one active polyline theme.

Find Self-Intersecting Segments

Searches for segments in the active theme that are self-intersecting.

- Searches selected shapes (or all shapes, if none are selected).
- Shows as graphics.
- The active document must be a view and must contain at least one active polyline theme.

Get Intersections

Searches segments in the active theme for intersections.

- Searches selected shapes (or all shapes, if none are selected).
- Saves as shapefile or shows as graphics.
- The active document must be a view and must contain at least one active polyline theme.